

ELECTRONIC FUNDAMENTALS

SERVICE PRACTICES 12

BATTERY AND THREE-WAY PORTABLE RECEIVERS

- 12-1. The Personal Portable Receiver
- 12-2. The Three-Way Portable Receiver
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A SERVICE OF RADIO CORPORATION OF AMERICA

HOME STUDY SCHOOL

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Service Practices 12

INTRODUCTION

In this Service Practices booklet, you will learn how to correct many of the troubles that are found in portable radio receivers. As much as is possible, the troubles that are discussed in this booklet are those that are found only in battery-operated and three-way portables. These troubles are not difficult to locate, nor do you need a lot of experience or a wide knowledge of radio circuits in order to find them. Troubles that are found in other types of radio as well as in portables, will be discussed in later Service Practices booklets.

Two modern types of portables are shown in Fig. 12-1. The one shown in Fig. 12-1a is a personal-type portable radio receiver that is powered only by batteries. The carrying handle of the one shown can be folded flat on the side of the case so that it may easily be carried in a coat pocket. This type of receiver may be used on the beach, at picnics, and ball parks, on boat rides, and many other places where line-powered receivers cannot be used. The radio receiver shown in Fig. 12-1b is known as a three-way portable because it operates on battery, d.c., or a.c. It may be plugged into an electric outlet where one is available, or may be operated when other power sources are not convenient. The two types shown are typical of most portables.

12-1. THE PERSONAL PORTABLE RECEIVER

Your first step in learning how to service portable receivers will be to study the receiver shown in Fig. 12-1a. Supposing that a radio of this type has stopped playing,



(a)



(b)

Fig. 12-1

the two most likely causes of trouble would be: (1) defective cells or batteries or (2) defective tubes. Figure 12-2a shows two 1.5-volt dry cells, which, when connected together in parallel, are called the "A" battery. The 67.5-volt battery shown in Fig. 13-2b is called the "B" battery. The "A" and "B" batteries, together, supply the

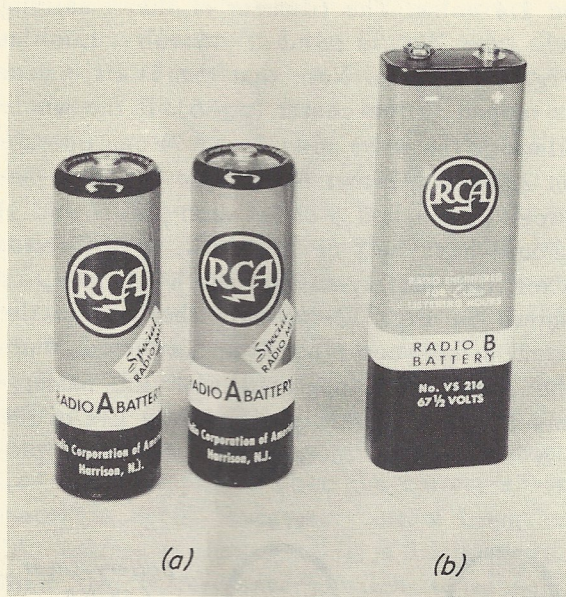


Fig. 12-2

electrical operating power for the receiver.

Electrical Connections to the Batteries.

The two 1.5-volt cells that make up the "A" battery and the 67.5-volt "B" battery all fit snugly inside the personal-portable case. They are easily reached by removing the back of the case. This is done by placing a small coin or screwdriver in the slot at the top rear of the case and prying it

open. In other personal portables, the back may be hinged to the case. In such cases, the back is opened but not removed.

The outer metal case (the negative terminal) of each cell that makes up the "A" battery in the receiver shown presses against an "A" battery clip, which, in turn, is connected to the chassis. This connects both negative terminals together. The positive terminal of each cell (the brass center contact) is connected to one of the two + "A"-battery connectors that are wired together. This connects the positive terminals together and to the receiver.

Electrical connections from the receiver to the 67.5-volt "B" battery are made by means of the "B"-battery connector. This is an insulated strip that has two small metal snap-fastener contacts. A connector wire is permanently attached to each snap-fastener contact. The strip is snapped on the terminals of the "B" battery, and the connections are made. Most personal portables use similar "B"-battery connections.

The Filament Circuit. In Fig. 12-3, batteries are used to power a radio. The battery that supplies the filament voltage is always called

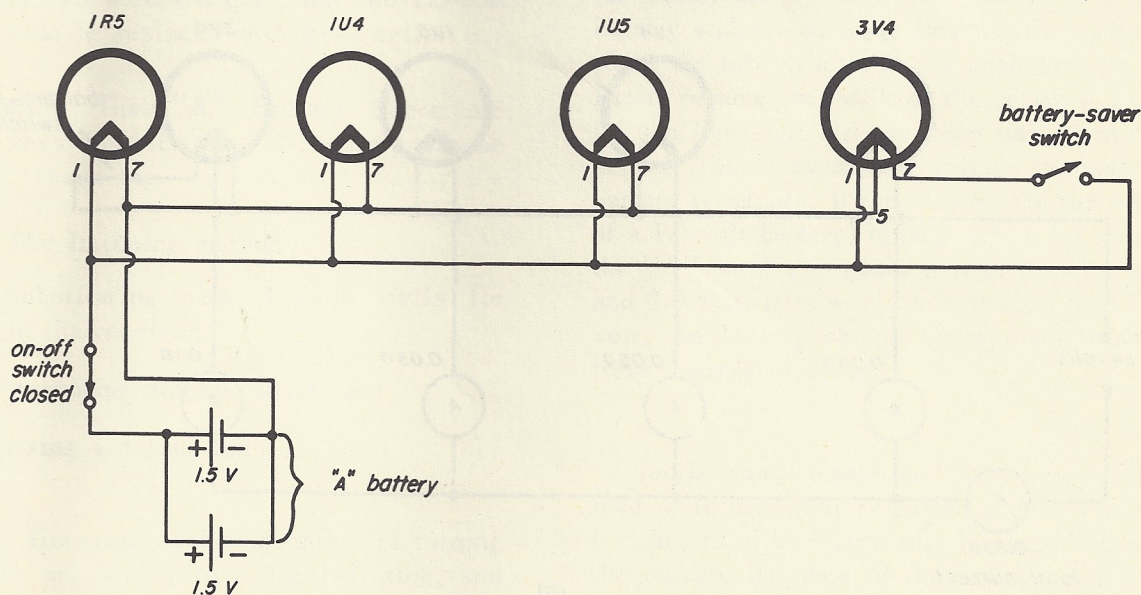


Fig. 12-3

the "A" battery. The two 1.5-volt cells are connected in parallel to form the 1.5-volt "A" battery that forces current to flow through the filaments; this current causes the filaments to get hot. The filaments of the tubes are parallel-connected and placed across the terminals of the "A" battery when the on-off switch is closed.

Battery-Saver Switch. The filaments of three of the tubes used in this receiver, the 1R5, 1U4, and 1U5, are designed to operate

on 1.4 volts. The filament of the remaining tube, the 3V4, is rated at 2.8 volts. Look at Fig. 12-3 again. Note that the 3V4 filament is tapped in the center (pin 5). If the whole filament (between pins 1 and 7) can operate on 2.8 volts, either half of the filament (between pins 1 and 5 or between pins 7 and 5) should have half of 2.8 volts, or 1.4 volts. When the battery-saver switch is open, as shown in Fig. 12-4a, only the part of the filament between pins 1 and 5 is used. When the receiver is operated with the battery-saver switch in this position, the life of the "A" battery is increased by about 30 per-

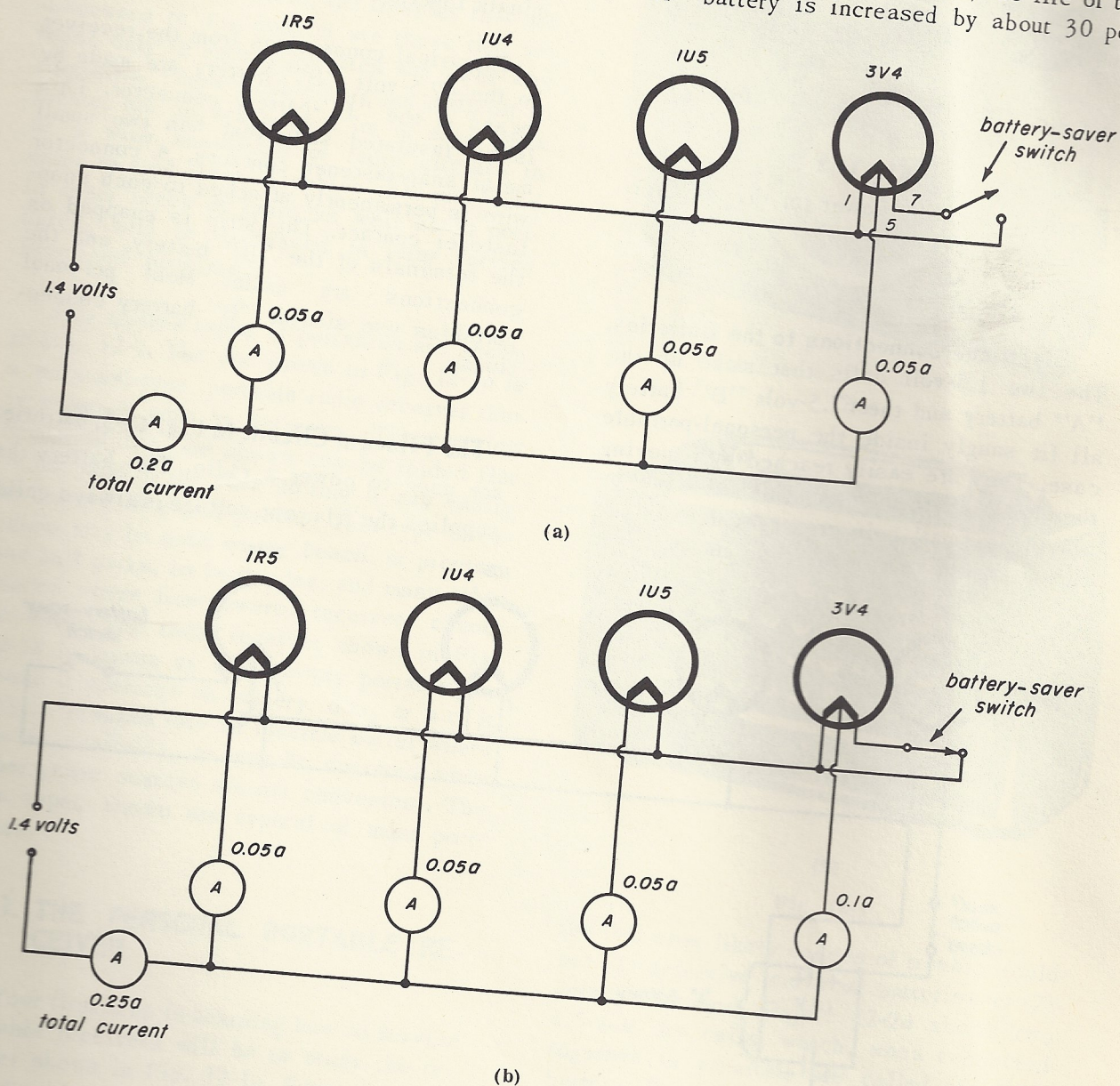


Fig. 12-4

cent. However, when greater sound power or volume is wanted from the loudspeaker, the switch is closed, as in Fig. 12-4b. This connects the other half of the filament (between pins 5 and 7) in parallel with the first half, so that each half receives 1.4 volts. With both halves of the filament heated, twice the number of electrons are emitted. This increases the power delivered by the tube to the speaker. As a result, the sound from the speaker is louder. You may wonder why the 1.5-volt "A" battery delivers only 1.4 volts to the tubes. Here is the answer: First of all, each tube filament draws 0.05 amperes (when the battery-saver switch is open). The total current from the "A" battery is then $4 \times 0.05 = 0.2$ amperes. When the battery-saver switch is closed, another 0.05 amperes is added — making 0.25 amperes in all. You remember from your study of batteries that the terminal voltage of a battery is less than the emf produced by chemical action because of the internal resistance of each cell. When the "A" battery draws 0.2 to 0.25 amperes, this internal resistance causes the terminal voltage to drop to about 1.4 volts. As the cells are used more, or start to dry up from age, the internal resistance becomes greater. This causes a greater drop in terminal voltage, and, as a result, the tube filaments do not receive sufficient voltage to heat them properly. When this occurs, the two 1.5-volt cells must be replaced with fresh cells.

Testing The "A" Battery. There are three ways in which the "A" battery may be tested. These are:

1. The listening method
2. Substituting new 1.5-volt cells for those in the receiver
3. Measuring voltage under load
4. Using a dummy load

The listening method consists of turning the set on, tuning to a local station, and listening to the receiver. If it operates with good volume, without the station fading

away, the "A" battery is in good condition. If the station is heard for a short time, and then dies away, it is almost certain that the "A" battery is no longer usable and should be replaced with new cells.

If you had a flashlight that gave very little light, you probably would find out whether or not the cells were at fault by substituting new cells for the old ones. Then you would try the flashlight and, if the light was bright, you'd know that the old cells were no longer any good. So, in a battery portable, if you suspect that the "A" battery is no longer usable, you can use the same substitution method. Just remove the old battery (or cells) and substitute a new battery (or cells). At the same time, it is a good idea to replace the "B" battery with a new one. If the set works properly, with no loss in volume, it is almost certain that the old "A" battery is no longer usable and should be replaced. In some portables, such as this one, the "A" and "B" batteries are designed to be replaced at the same time. So, if a new "A" battery is needed, a new "B" battery will be needed too.

However, if you want to be sure that you are right, you can use the third method, which is to test the voltage of the battery (or cells) under load. One way to test the battery under load is to measure the voltage when the tube filaments are connected to it. First, remove the back of the receiver case (if you have not already done so). Turn the set on. Then measure the voltage across the battery terminals. If the voltage (in the case of a 1.5-volt battery) is from 1.5 to 1.2 volts, the "A" battery is good. If it is between 1.2 and 0.9 volt, it is weak. If it is less than 0.9 volt, the battery should be replaced with a fresh battery or cells.

Another way to test the "A" battery under load is to use what is called a *dummy load*. It consists of a resistor that is placed across the battery in place of the filaments of the tubes. The value of the resistor used in the dummy load is equal to the resistance

offered by the tube filaments when heated. This may be found by dividing the filament voltage by the total current flowing in the filament circuit, as follows:

$$R = \frac{E}{I} = \frac{1.4}{0.25} = 5.6 \text{ ohms}$$

R = the resistance of the dummy load

E = the "A"-battery voltage

I = the total current drawn by tubes

With a 5.6-ohm resistor placed across the battery, the voltage is measured at the battery terminals, and the battery reading should meet the same standards as it does when tested under normal load.

A radio-battery tester such as the RCA WV-37A, shown in Fig. 12-5, permits you to test radio dry-cell batteries without placing them in a receiver. Such a tester is useful when a customer comes to your shop with batteries for testing and when you want to check the condition of any batteries and cells that you have in stock. Such a tester has a resistor for each value of dummy load necessary to test each kind of radio battery. The proper dummy load is selected by means of a switch. If you have the time and parts, you can make a similar tester to use with your multimeter.

The "B" Battery-Circuit. When batteries are used to power a radio receiver or other electronic equipment, the battery that supplies the plate or anode voltage for the tubes is always called the "B" battery. The "B" battery used in this personal portable radio is rated at 67.5 volts. It is made up of 46 1.5-volt cells connected in series, which means that the no-load voltage of a new battery should be about 69 volts. Only 5.45 ma of current is drawn by the receiver when the battery-saver switch is in the open, or battery saver, position, and 8.45 ma of current is drawn when the switch is closed in the normal position. Even when

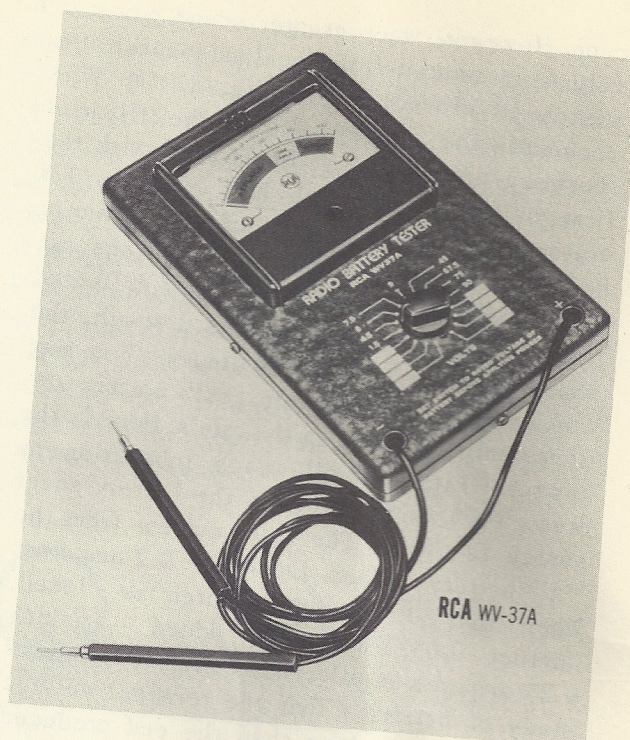


Fig. 12-5

the battery is fresh, there will be a small voltage drop due to internal resistance; therefore, the terminal voltage under load may be less than the rated 67.5 volts. As the battery ages and is used up, the voltage drop increases until the terminal voltage under load is not enough to operate the receiver. Then the "B" battery must be replaced with a new one.

Testing the "B" Battery. The "B" battery is tested in the same four ways as the "A" battery is. When a "B" battery is tested under a dummy load, the resistance of the dummy load is much higher than that for an "A" battery. The maximum current drawn from a "B" battery is 8.45 ma. Therefore, the resistance of the load is found as follows:

$$R = \frac{E}{I} = \frac{67.5}{0.00845} = 7,987 \text{ ohms}$$

The power rating of the resistor used for the dummy load is found by calculating the power consumed by the resistor:

$$W = I^2 R = (0.00845)^2 \times 7,987$$

It is easier to work with powers of ten, so:

$$\begin{aligned} W &= 8.45 \times 10^{-3} \times 8.45 \times 10^{-3} \\ &\quad \times 7.99 \times 10^3 \\ &= 71.4 \times 10^{-6} \times 7.99 \times 10^3 \\ &= 0.5705 \text{ watts} \end{aligned}$$

From your calculations, you can see that a 1-watt carbon resistor will serve as our dummy load. However, the nearest RETMA resistor value is 8,200 ohms, so the dummy load will be an 8,200-ohm 1-watt resistor. When testing the "B" battery under load, the receiver should be on, or the dummy load applied, for two minutes before making voltage measurements. If the terminal voltage is between 67.5 and 54 volts, the battery is in good condition. If the voltage is between 54 and 37 volts, the battery is weak. If the reading falls below 37 volts, the battery should be replaced. Remember, with this receiver, that it is best to replace both "A" and "B" batteries at the same time. In other receivers, this may not be so. In fact, in some receivers, the "A" batteries may be replaced 3 or 4 times before it is necessary to replace "B" battery.

The Electron Tubes. If the receiver is not working properly and the batteries test *good*, the next most likely trouble is that one of the tubes is defective. Defective tubes cause trouble in all kinds of electronic equipment, so we cannot say that a defective tube is a trouble found only in portables. However, the tubes used in portable radios may have defects not often found in the tubes in line-power operated receivers. For example, tubes used in portables usually have directly-heated cathodes (filaments). These filaments are made from very fine resistance wire, and are easily broken. In addition, because they are designed to operate on very low vol-

tages, they are easily burned out if batteries are replaced carelessly.

There are four common faults found with the electron tubes used in personal portables, any one of which could prevent the receiver from playing. These are:

1. Burned-out or broken tube filament
2. No emission or weak emission from heated filament
3. Shorted elements within tube
4. Cracked glass envelope

You learned, from your study of Service Practices 10, the way in which to use a tube tester to test tubes. You also know, in many cases, tubes are checked by the substitution method, where one tube at a time is replaced with a tube known to be good until the defective tube is found. However, it is possible that you might not have one or more of the tubes to substitute for those in the receiver. Lacking a tube tester, you might still be able to locate the defective tube — particularly if it is burnt out.

At first glance, it might appear that there is no problem — all that has to be done is to see which tubes light up. However, this is not quite so simple to do. With most radio and television receivers, we can tell that the filament or heater of a tube is good by the fact that it lights up, glows, or, if it is a metal tube, becomes warm. The tubes used in most battery receivers do not light up enough so that we can see that the filament is good. In addition, the tubes consume so little power that they seldom get warm. So, we must use another method to test for an open or burned out filament. All that we have to do is to use an ohmmeter to test the filament for continuity. To do this, we must know at which tube pins the filaments terminate. For this information, we go to our tube manual. For example, we find that the 1U5 tube filament terminates in pins 1 and 7. Using the R x 1 ohmmeter range, we connect one test prod to pin 1

and the other to pin 7, as shown in Fig. 12-6. If the filament is good, the ohmmeter will show a deflection of about 25 ohms. If there is no reading, that is, if the needle stays at the left-hand side of the scale, then the filament is open and the tube is defective.

The 3V4 tube, and other tapped-filament type tubes, need two filament checks. In the case of the 3V4 tube, one check is made by touching the ohmmeter test prods to pins 1 and 5; the other check is made by touching the ohmmeter prods to pins 5 and 7. In each check, the reading on the R x 1 ohmmeter scale should be about 25 ohms. An over-all check might be made between pins 1 and 7. A normal reading would be about 50 ohms.

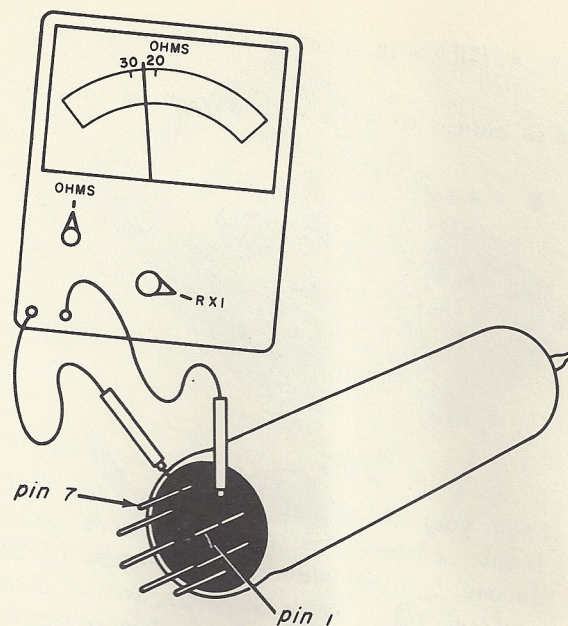


Fig. 12-6

pin tubes. Each pilot, as shown in Fig. 12-7, has a center pin that locates the center of the socket and permits easier insertion into the socket. A pilot may be used only where the socket has a center hole.

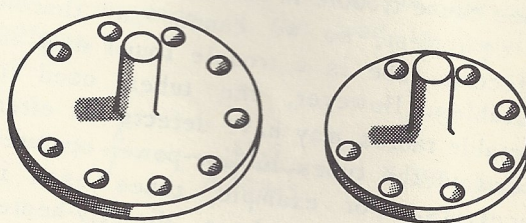
Caution: It is safe to test any 1.4-volt filament with the ohmmeter section of the multimeter that you have constructed. However, filaments made to operate on lower voltages will burn out as you test them. In addition, while you can test 1.4-volt filaments with your ohmmeter, some other ohmmeter might use more than 1.5 volts in its low-ohms range, place too much voltage across a filament, and burn it out. So, do not make this filament check on 1.4-volt tubes with any other ohmmeter unless you know that it is safe to do so.

Tubes with loose or shorting elements and tubes that are weak cannot be tested with an ohmmeter. The only way to test such tubes is by substitution or by a tube-checker test. A tube with a cracked glass envelope sometimes has a milky white coating on the inside of the glass.

The small miniature tubes used in personal portables must be handled with great care. If too much pressure is applied to the tube pins, they may bend or cause a crack in the glass envelope. After each tube has been checked, it should be returned to its socket. Sometimes this is difficult to do because the socket holes for the tube pins cannot readily be seen. *Tube pilots* are made that may be slipped over the pins of miniature 7- and 9-

Other Troubles. Methods used in troubleshooting receivers for different kinds of defects will be discussed completely in later Service Practices booklets. You will find that the methods used to locate trouble in large radios apply equally well in checking portables. However, there are some troubles that you may find without knowing much about troubleshooting. Some of these are:

1. Broken wire



tube guide

Fig. 12-7

2. Bared leads touching
3. Broken carbon-composition resistor
4. Loose connection

To locate some of these defects, it is necessary to remove the chassis from the cabinet. Each personal portable is fastened in its cabinet with screws or other fasteners. For example, the portable you have been studying is fastened to its cabinet by four screws, which are marked *A* in the drawing of Fig. 12-8. To remove the chassis, all that is necessary is to unscrew these four screws. Other personal portable chassis are removed in a similar manner. It is best to have the service notes to guide you when you remove any chassis from its cabinet. Yet it is possible, with a little experience, to locate the mounting screws and to remove the chassis without such notes.

Caution: When removing the chassis, be sure to handle the speaker with care in order to avoid tearing the paper cone.

In addition to the four mounting screws, it is necessary to remove the tuning knob and, in some receivers, the volume-control knob. No general rule can be made that will cover all cases. However, even without service notes, you can find out what must be done to remove a particular chassis by

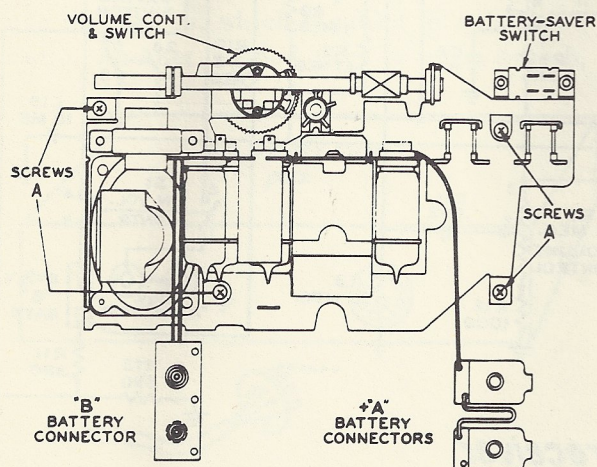


Fig. 12-8

examining the receiver carefully *before* trying to remove the chassis. It is very important that you remember how you remove a chassis so that you can replace the chassis in its cabinet after examining it.

Once the chassis is out of the cabinet, you can check it for some of the troubles mentioned above. First of all, make sure that the battery leads (like those shown in Fig. 12-8) are not broken and that the battery clips make good contact with the batteries or cells. Next, carefully place the chassis in a position that will allow the wiring and parts to be seen. Inspect each wire and soldered connection, making sure that there are no breaks or loose connections. Be sure that the bare leads going to resistors, capacitors, and coils do not touch each other. Reconnect the "A" and "B" batteries while the chassis is still out of the case. Turn on the set and turn the volume-control knob all the way to its loudest position. Rock each of the four tubes gently back and forth in its socket to see if there is a poor connection between the tube pins and the socket contacts. If the set suddenly starts to play when one of the tubes is rocked, a base pin of one of the tubes is making faulty contact with its socket contact. Push against each carbon resistor gently with the end of a pencil to see if the resistor breaks in two; sometimes a carbon resistor is already broken and will not show up unless slight pressure is used. When the trouble has been found and corrected, turn off the set, disconnect the batteries, and reinstall the chassis in its case. Use the manufacturer's service notes for the radio receiver or reverse the order of the steps you used in removing the chassis.

Sometimes portables receive only a few stations or operate with low volume. This may not always be due to weak batteries or tubes or to a defect in the receiver. Instead, it may be due to the location in which the receiver is operating. Sometimes by moving the receiver to another part of the room or by turning it in a different direction, reception may be improved. If the location is far from the local radio stations, such as at a

mountain vacation resort, the set may not be sensitive enough to give loud clear volume in any position. Other locations that also result in weak or no reception are inside steel-framed buildings, subways, and railroad or automobile tunnels.

The schematic for the personal portable set is shown in Fig. 12-9.

12-2. THE THREE-WAY PORTABLE RECEIVER

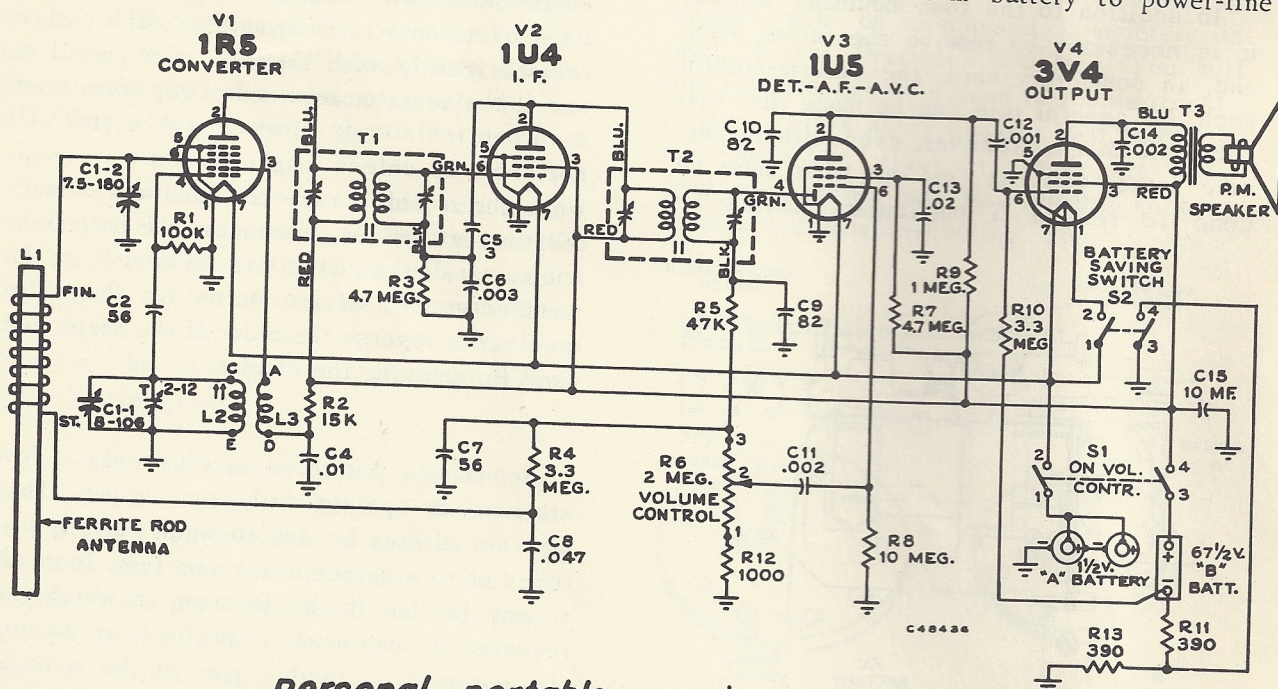
A three-way portable receiver operates from any of three power sources: a-c line current, d-c line current, or batteries. Because there is this choice of power source, some troubles in three-way portables are easily found. You will see why this is so as you read further in this booklet. Of course, all of the troubles that you might find in one of these portables cannot be discussed in this booklet. So, we'll discuss only those defects that are found in such a portable.

The three-way portable receiver that was shown in Fig. 12-1b is more sensitive than the personal portable receiver you have been studying. The three way portable can receive weak signals from

more distant stations because the signal picked up by the antenna is first amplified by the 1T4 (V_1) before it is fed to the 1R5 (V_2) converter tube (shown in Fig. 12-10). In addition, all of the tubes operate on higher "B" voltages, which provide greater power output.

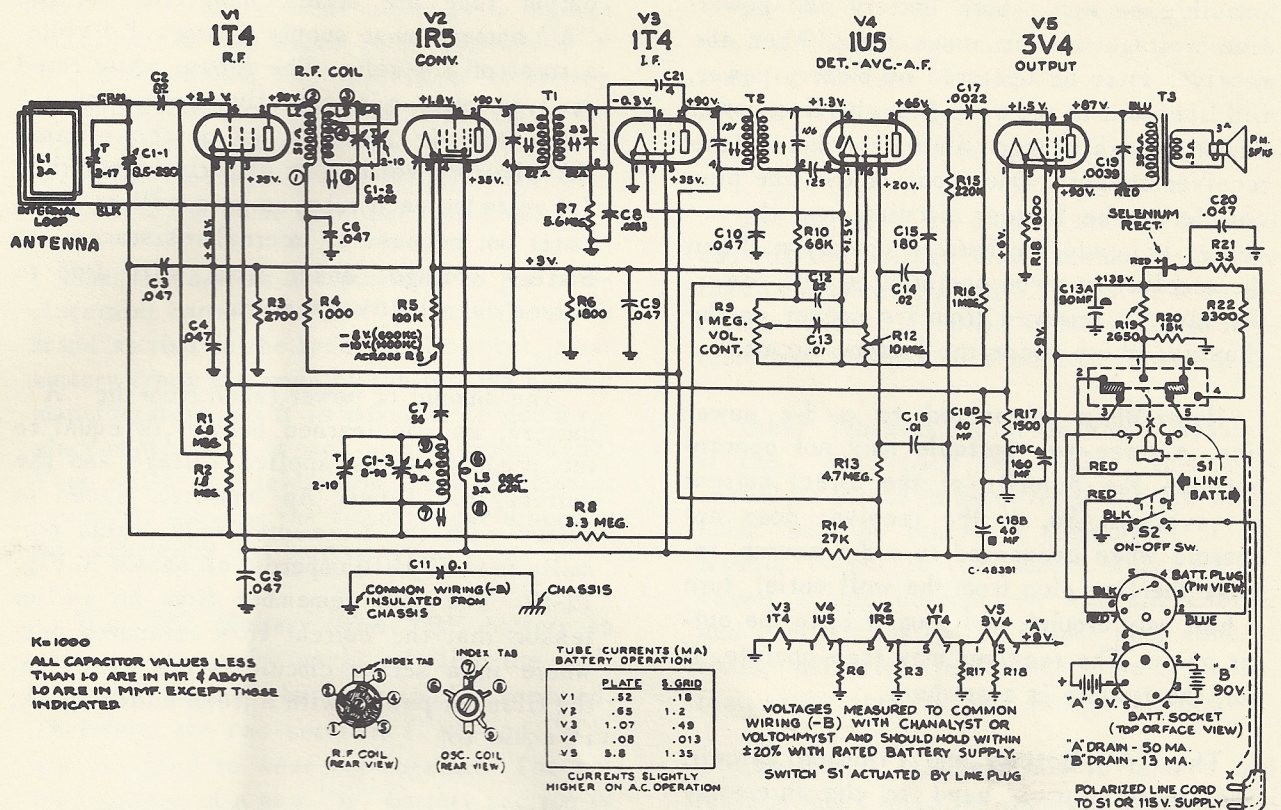
There are five tubes, all having filaments that operate from "A"- and "B"-battery power when the set is used as a portable receiver. The "A"- and "B"-battery power for this set, as shown in Fig. 12-11, consists of a 9-volt "A" battery and a 90-volt "B" battery, both assembled within the same container by the battery manufacturer. Electrical connection to the combination "A" and "B" battery, which is called a *battery-power pack* or an "AB" pack, is made by means of a plug with prongs that fit into a socket connection that is part of the power pack, as shown in Fig. 12-12. A cable is permanently connected to the plug having leads that go to the filament and plate circuits of the receiver.

Any three-way portable must provide some way to switch from battery to power-line



Personal portable receiver

Fig. 12-9



three-way portable receiver

Fig. 12-10

operation because, without such switching, it would be possible to apply both battery and line current at the same time; this, in some cases, might burn out the tubes. Some of the earlier portables had a switch on their front panels for this purpose. However, sometimes the operator of the set forgot to use the switch, which resulted in a damaged radio. Another method used a relay switch,

which was supposed to open the battery circuit when the power cord was connected to the power line. These relays sometimes were slow in switching or didn't operate at all, which caused damage. Modern portables use a system that is simple and makes it im-

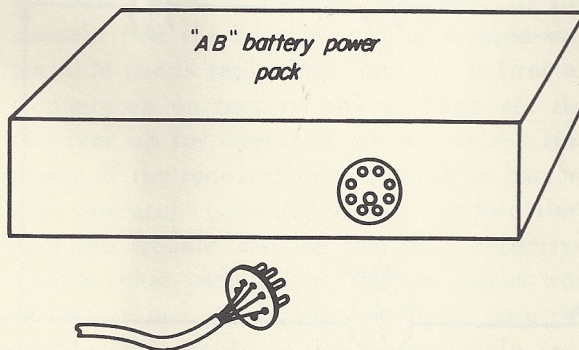
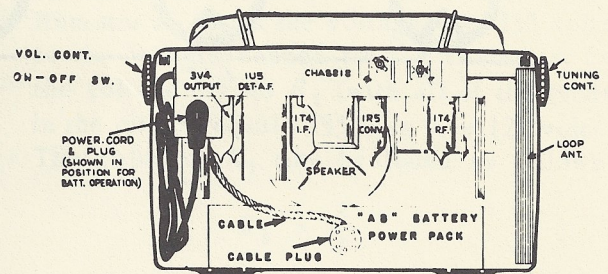


Fig. 12-11



rear view of three-way portable with back removed

Fig. 12-12

possible to apply both battery and power-line voltage at the same time. When the receiver is to be operated on battery power, the line cord is removed from the line power outlet and is plugged into a socket on the receiver chassis. One prong of the line plug completes the battery circuits, and the receiver is ready for battery operation. When the receiver is to be operated on line power, the plug is removed from its socket on the chassis, which opens the battery circuit.

Note: When connected to a d-c power line, a three-way portable may not operate because the polarity of the direct current is reversed. So, if the receiver does not operate when connected to a d-c source, remove the line plug from the wall outlet, turn it half way around, and plug it in to the outlet again. The receiver may then operate. If not, the trouble is elsewhere.

The "A" Battery and Filament Circuit.

The battery pack used in the three-way portable shown in Fig. 12-11, provides 9 volts of "A"-battery power. You may wonder why this is so, for this receiver uses the same 1.4-volt tubes that the personal portable uses. The schematic diagram of the filament circuit, in Fig. 12-13, shows the reason. Instead of being connected in parallel, as in the personal portable, the filaments of this three-way portable are connected in series. Even the two sections of the 3V4

output tube are series-connected. So, the "A" battery must supply 6 times 1.4 volts, a total of 8.4 volts. The tubes, while rated at 1.4 volts, can actually operate on 1.5 volts without damage. So, if the original "A" battery voltage is slightly higher than 1.4 volts for each tube, no harm will be done. Later on, because of internal resistance, the battery voltage, under load, will drop to values even below 1.4 volts.

The amount of power taken from the "A" battery, as you learned before, is equal to the product of the applied voltage and the current that flows. An ammeter placed in series with the filament circuit would normally read 50 milliamperes, as shown in Fig. 12-13. You will remember from an earlier lesson that the current flow measured anywhere in a series circuit is the same. So, the filament power, with a fresh battery pack, is equal to:

$$P = E \times I = 9 \times 0.05 = 0.450 \text{ watt}$$

where:

E = the total filament voltage

I = the total current flow

Some three-way portables require only 6 or 7.5 volts of "A"-battery voltage. There-

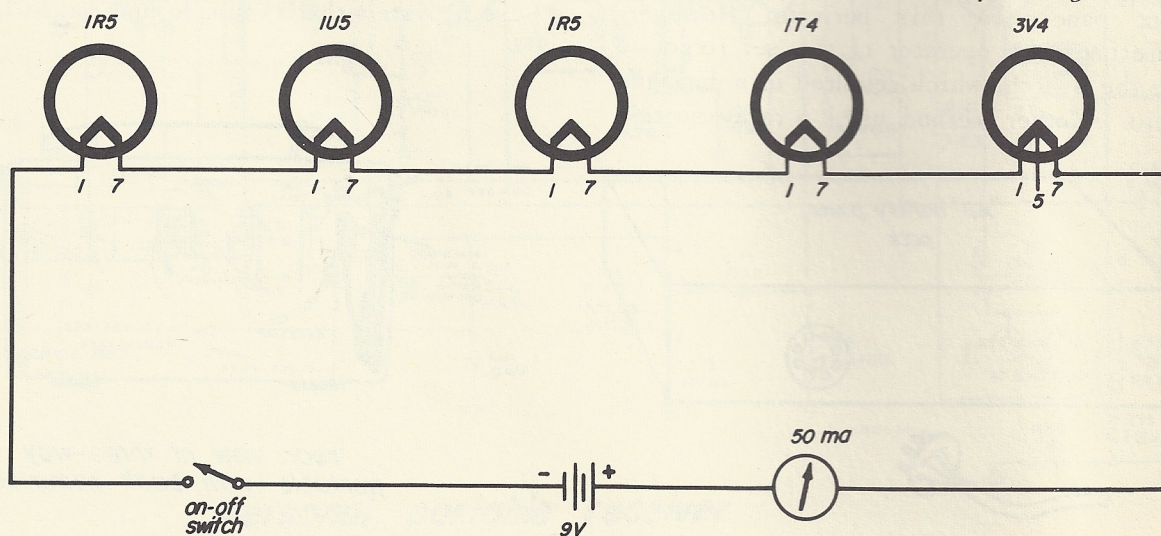


Fig. 12-13

fore, "AB" battery packs are made in voltage combinations and sizes to fit the needs of the many brands and models of three-way portables that have been and are being made. When servicing a three-way portable, it is necessary to replace the "AB" pack with another of the same size and voltages.

Sometimes it is not possible to get a replacement battery or "AB" pack of the same brand as that in the receiver. However, most battery types are made by the leading battery manufacturers, so it is possible to get a replacement battery or pack in a different brand. Your radio and television parts distributor has a list showing the manufacturer's number for each brand and battery type.

The "B" Battery. The "B" battery is part of the battery pack and, like the "A" battery, cannot be separately removed. Therefore, the two sections ("A" and "B") are designed to wear out together. The no-load voltage of a new "B"-battery section is 90 volts, and the current drain in the receiver you are studying is 13 milliamperes. Most modern three-way portables use somewhat the same tube line-up; therefore the "B" current drain ranges between 12 and 14 milliamperes for a standard three-way portable.

Testing the Battery Pack. The battery pack may be tested by using the listening method, the battery-substitution method, or by testing the voltages under normal load or dummy load. There is one test that can be made with a three-way portable that is not possible with a battery portable. If you suspect that the battery pack of a three-way portable needs replacing, listen to it first as it operates on battery power. Then set the receiver up for operation on a-c or d-c line power. If the receiver is very weak on battery and operates normally on the power line, then the trouble may be due to a defective tube or other part. If the receiver works well on battery and poorly on power line, then the trouble is probably in the power-supply section of the receiver. Locating troubles in power supplies is discussed fully in another of these Service Practices booklets.

The 9-volt "A"-battery section is rated *good* if the voltage under normal or dummy load is between 9 and 7.2 volts. If it is between 7.2 and 5.4 volts, it is weak. If it is less than 5.4 volts, it should be replaced.

The 90-volt "B" battery section is rated *good* if the voltage under normal or dummy load is between 90 and 72 volts. If it is between 72 and 54 volts, it is weak. If it is less than 54 volts, it should be replaced.

Other Troubles in Three-Way Portables.

If the "AB" pack tests *good*, the tubes should be tested to discover if any are weak, burnt out, or otherwise defective. If the trouble is not in the tubes either, the receiver should be removed from the cabinet and checked for broken leads, poor connections, defective resistors, shorting leads, faulty tube sockets, and similar defects.

Caution: It is dangerous to remove and replace tubes when the receiver is connected to the power line and the set is operating.

Examine Fig. 12-14. It shows the filament circuit (simplified) of a typical three-way portable when the receiver is set up for operation on power-line voltage. As you can see, the filaments of five tubes are connected in series, with one end connected (through ground) to the negative side of the power supply circuit. The other end is connected (through R_1) to the positive side of the power-supply circuit. The power supply shown feeds 135 volts to the series circuit. Resistor R_1 drops the voltage from 135 volts to the 9 volts needed for the filaments. So the voltage across R_1 (with all of the tubes in the circuit) equals 135 less 9, or 126 volts. The value of R_1 may be found as follows:

$$\begin{aligned} R_1 &= \frac{E}{I} \\ &= \frac{126}{0.05} \\ &= 2,520 \text{ ohms} \end{aligned}$$

where:

E = the voltage across the resistor

I = the current flowing in the circuit

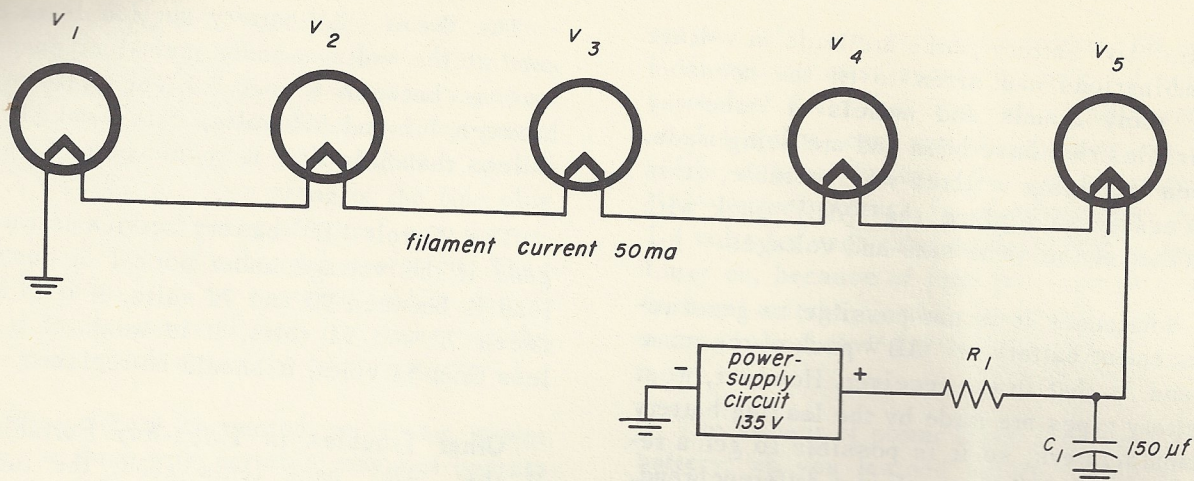


Fig. 12-14

When the filament circuit is complete, the voltage drop across R_1 will be normal and each tube filament will receive the proper voltage. However, when a tube is removed from its socket, the circuit is opened, and there will be no voltage drop across R_1 . Therefore, when the filament circuit is open, the voltage on the filament side of R_1 will be 135 volts. This will charge the capacitor, C_1 , to 135 volts. If you then replace the tube in its socket, the 5 filaments, which need only 9 volts, will have 135 volts across them. One filament is almost sure to burn out. Therefore, always be sure to remove the plug from the wall outlet before testing tubes in a three-way portable.

The filament circuit that we have just discussed was simplified. The filament circuits of most modern three-way portables will show resistors connected to the filaments in the manner shown in Fig. 12-15. The

filaments of these tubes are also the cathodes, so they must carry plate current. Without these resistors, the filaments nearest the grounded end of the filament string would have a greater amount of current flowing through them, and would, therefore, have a greater voltage drop across them. This would result in unequal filament voltages.

If a three-way portable is operated on a power line that is heavily loaded by kitchen or other home devices, the voltage may be too low to operate the receiver when it is plugged into an outlet to which you also connect a toaster. Turn the receiver on and then turn on the toaster. You will note that the receiver volume drops immediately. In some cases it may stop operating entirely until the toaster is turned off. So, when a receiver operates satisfactorily on battery and is weak on the power line, check the voltage of the power line — you may find it low.

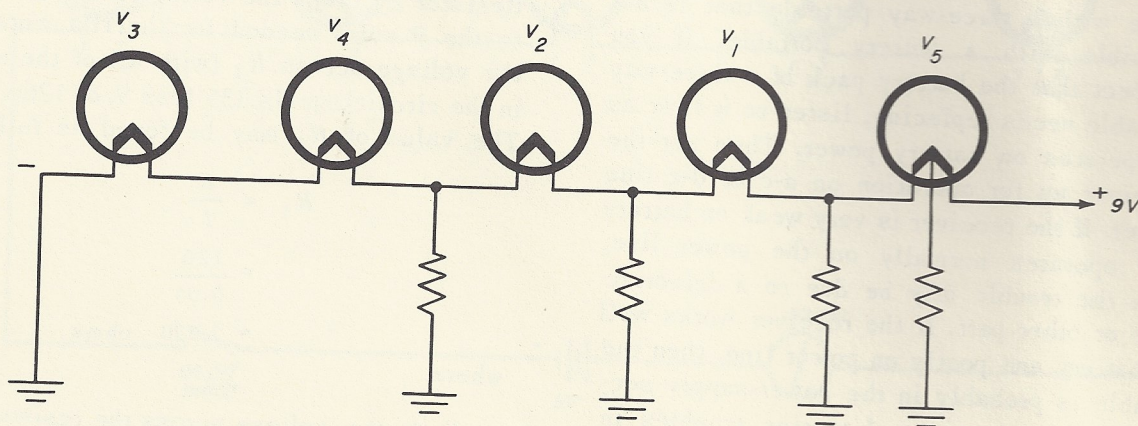
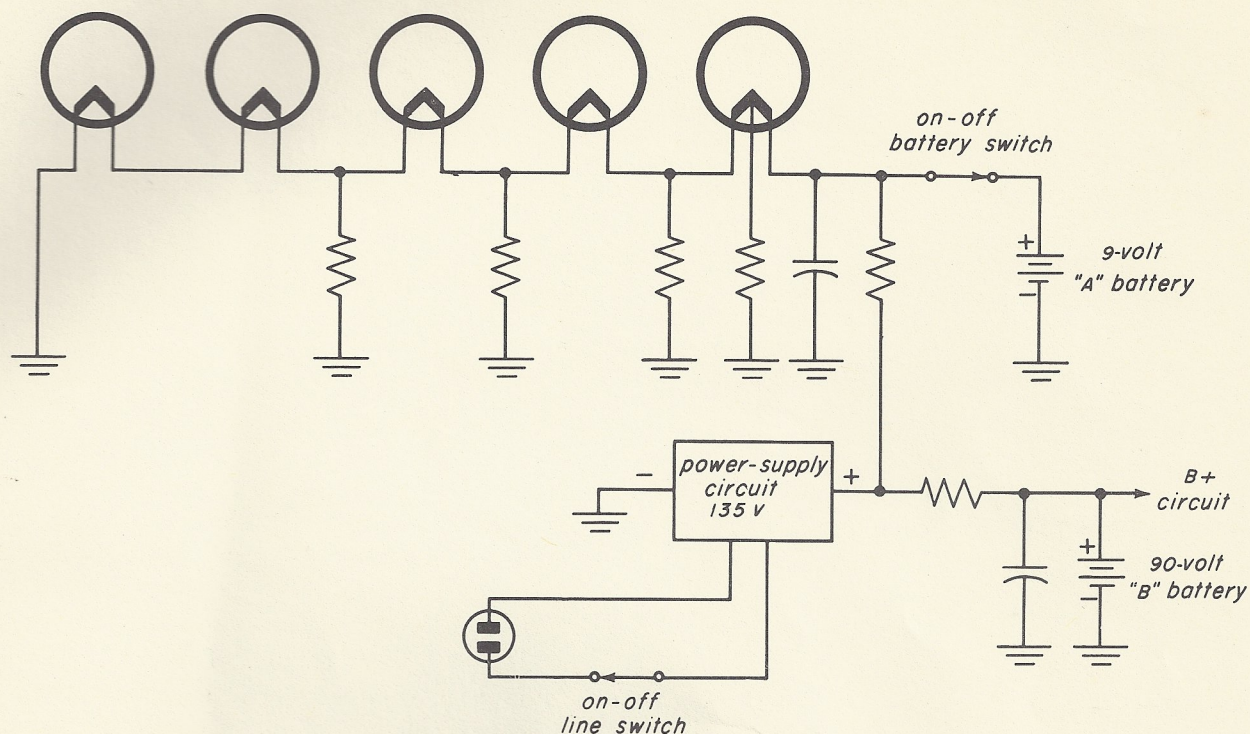


Fig. 12-15



three-way portable receiver set up for operation on power line and for recharging "A" and "B" batteries

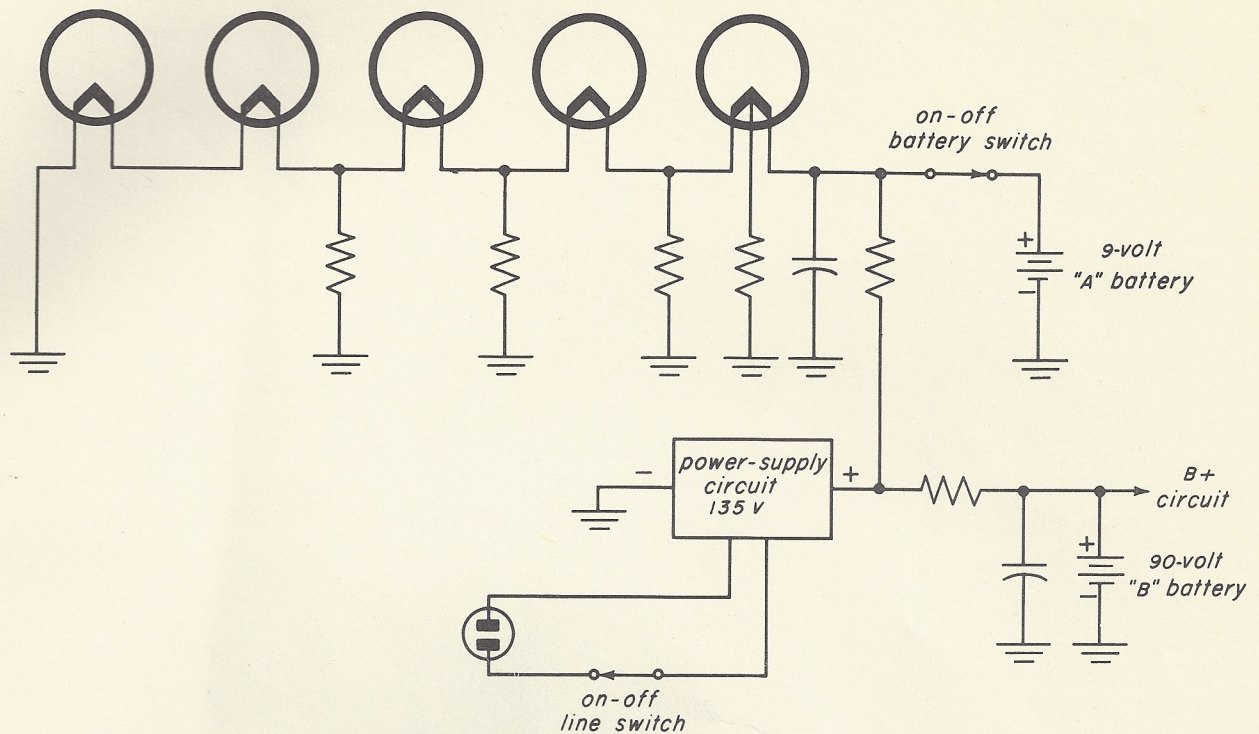
Fig. 12-16

If the receiver is noisy on battery operation and plays properly on power line, the battery pack may have a poor internal connection to the battery. Check the battery cable and plug. If the plug is corroded, clean each prong with fine sandpaper.

Remove Dead Cells and Batteries. Never allow dead cells or batteries to remain in a portable receiver. Some types of cells may leak or swell and cause damage to the chassis and its wiring. If batteries or cells swell, you may find it very difficult to remove them from the receiver. So, always remove dead cells and batteries immediately, even though you cannot replace them with new ones. Just leave the battery compartments empty until the time that the receiver is put to use again.

12-3. RECHARGING DRY CELLS AND BATTERIES

In some three-way portables, the batteries are connected to the power supply circuit when the receiver operates on power-line voltage, as shown in Fig. 12-16. The power-supply voltage will be higher than the battery voltage (except with fresh cells). The power-supply circuit will power the receiver and also renew the dry cells and batteries. Some manufacturers claim that this is a form of recharging; others say that the reverse current caused by the power-supply voltage depolarizes the batteries. At any rate, the effect on the operation of the dry cells and batteries is the same as recharging because cells and batteries connected in this way last much longer than separately connected cells.



three-way portable receiver set up for operation on power line and for recharging "A" and "B" batteries

Fig. 12-16

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